OP5251 USER GUIDE

Optically Isolated 32 Digital Inputs & 32 Digital Outputs Module

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GETTING STARTED

Before you begin, verify that your system meets the requirements of the OP5251 I/O board:

SOFTWARE REQUIREMENTS

- RT-LAB 8.4.0 and higher
- MATLAB 32 bits 6.5 and higher
- Windows XP and higher
- RT-XSG 1.3

HARDWARE REQUIREMENTS

- Opal-RT simulator:
  - Wanda box
  - Opal-RT I/O expansion box (only for use with Opal-RT simulators)

FEATURES

- 32 optically isolated input channels
- 32 optically isolated output channels
- All I/Os are sampled simultaneously for additional simulation accuracy. They can be sampled up to 5 MHz
- I/Os can be grouped in parallel for any size bus simulation
- User configurable filters, de-bounce time and conditioning inputs
- Choice of sink or source inputs (Factory Options for Common Anode or Common cathode)
- All inputs accept sources from 4V to 30V and limit the current via user interchangeable resistors on sockets grouped in 4 input or 8 output channels.

MODULE INSTALLATION

The OP5251 Digital Input Signal Conditioning Module must be inserted into the Opal-RT simulator using great care. Make sure that the card is properly aligned, using the guide tracks, before pressing into place.

INTRODUCTION

The OP5251 is a part of the OP5000 series of optional, versatile signal conditioning modules for Opal-RT's state of the art HIL (hardware-in-the-loop) systems. Designed for Opal-RT's simulation systems, the OP5251 provides digital input and output signals with specific voltage conditioning. The optical isolation of the OP5251 I/Os make it ideal for environments where voltage isolation is required.

DESCRIPTION

The OP5251 features 32 optically isolated input channels and 32 optically isolated output channels. All of these I/Os are sampled simultaneously for additional simulation accuracy. It is perfectly suited to interface real life environment signals to TTL or Differential for RT-LAB simulator, providing perfect electrical isolation and full short-circuit or discharge protection.

CIRCUIT LAYOUT DIAGRAMS

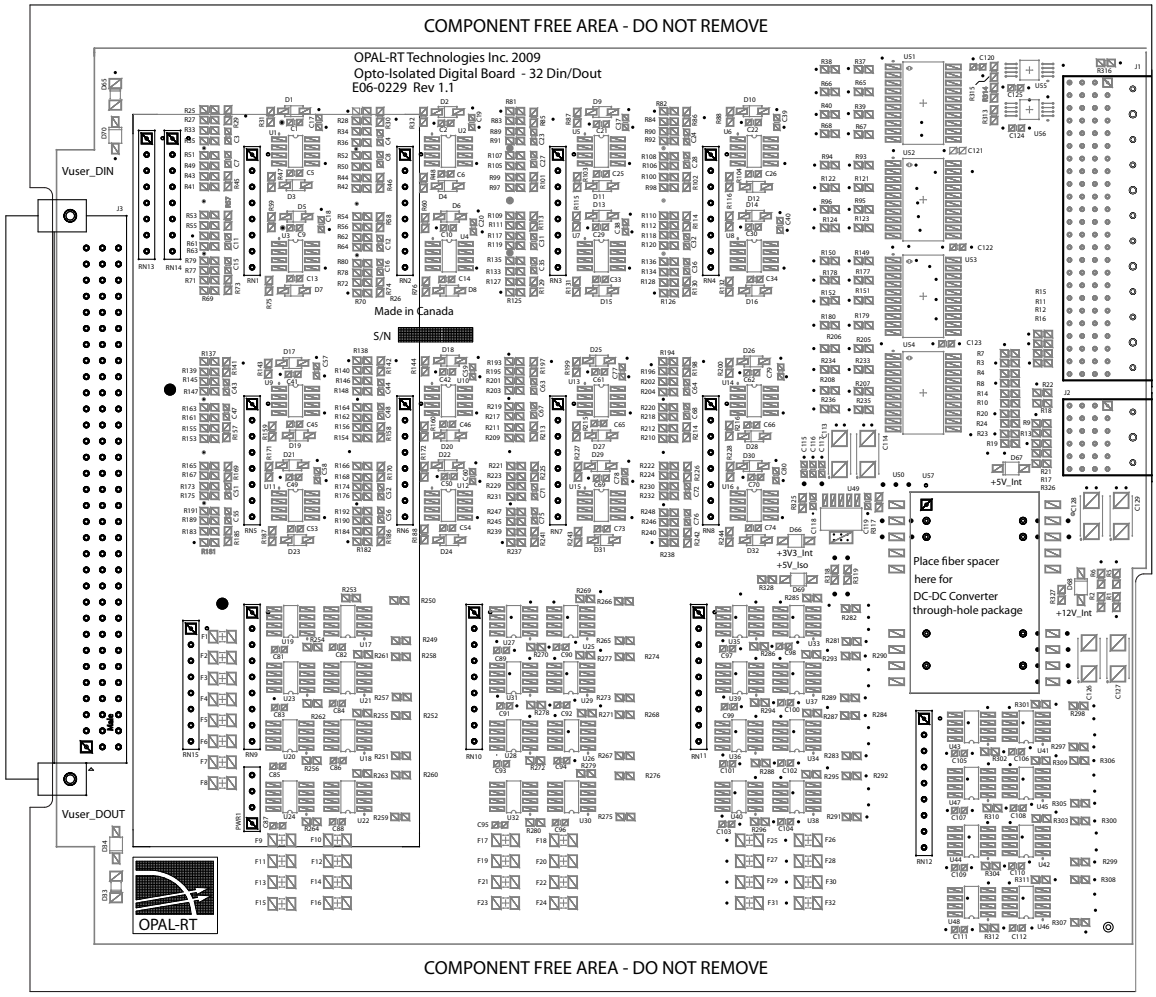


Figure 1: OP5251 Digital Signal Conditioning Module

RS-422 Communication Module

The communication module is offered as an option to convert the first 8 inputs and 8 outputs to differential I/Os, using an RS-422 cable.

The board is easily inserted onto the OP5251, over the connectors RN13, RN14, RN15, RN1, RN2, RN9 and PWR1. Consult the “Pin Assignments” table for details on pin connections and channels for the RS-422 cable.

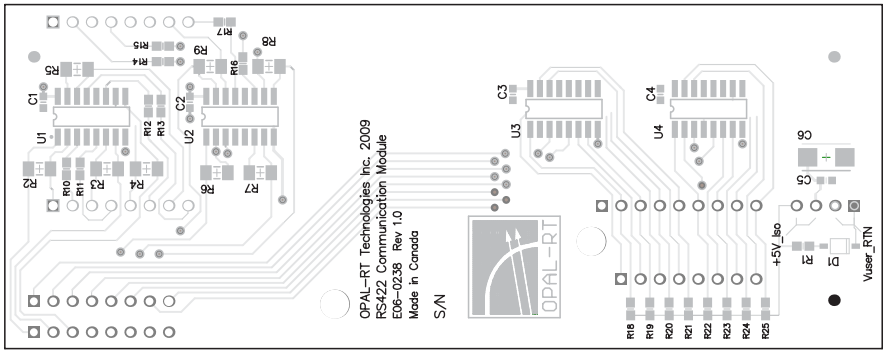


Figure 2: RS-422 Communication Module PCB Diagram

CAUTION Do not bend the pins when inserting or removing the RS-422 Communication Module into the OP5251.

INTERFACES

Inputs

The optically isolated inputs accept a wide range of input voltage, ranging from 4 to 30 Volts, according to user’s requirements. They have a low threshold current; typically 6 mA within the 5 to 15 mA range. The inputs are current limited by the interchangeable resistor array mounted on sockets. The resistor value may be changed by the user to enable higher input voltage.

By default, the module comes equipped with the resistor value set to 680 Ohms, which is recommended for 5 to 12 Volts input.

Each input has a reverse voltage protection of 5 Volts or more provided by a diode.

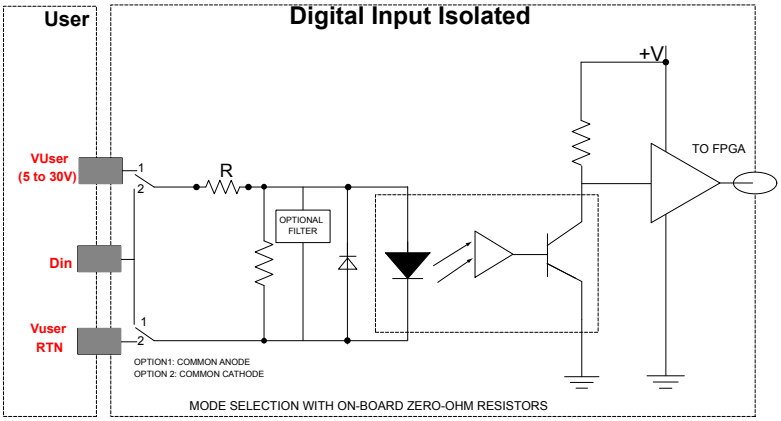


Figure 3: OP5251 Isolated Digital Input Drawing

The signal conditioning module inputs can be factory ordered to either common anode (default setting) or common cathode.

Figure 4: Common Anode (Push) mode and Common Cathode (Pull) mode

Each digital input channel is a positive logic circuit; a high input signal produces a high input state at the host data acquisition board. The source voltage (Vuser*) serves as the reference for the positive voltage level (see Voltage Range Selection).

* Vuser = 4 to 30 V+; Vuser RTN = 0 to -30 V

Note that if the input is mounted in common cathode mode then the channel becomes a negative logic circuit

Outputs

Each optically isolated output has an open collector transistor. It can sink up to 100 mA continuous, and up to +30V according to user's requirements. It is current protected by resettable 150 mA fuse (PTC). The onboard optical isolation circuitry requires an external power feed (Vuser).

CAUTION: If Vuser is connected to the simulator, the output of DOUT would be the same as Vuser Dout as long as no RT-LAB model is running (output transistor is open).

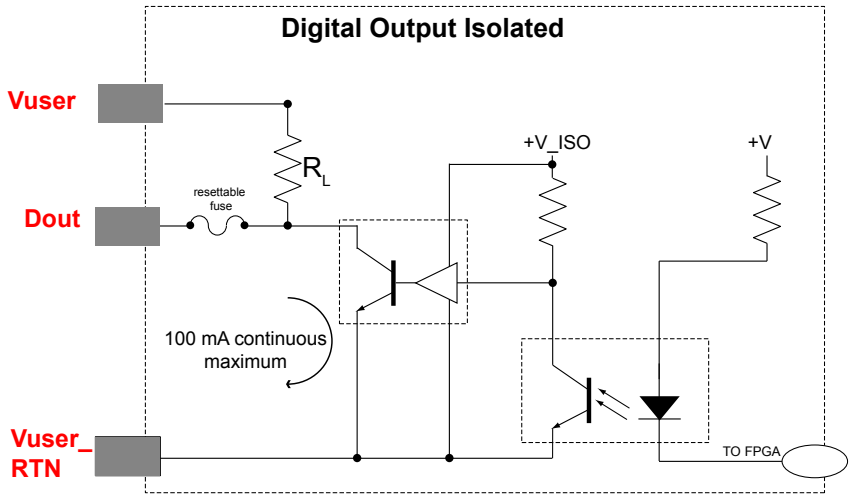


Figure 5: Isolated Digital Output Drawing (Pull only)

Interconnections

The OP5251 is a carrierless module. It fits directly into the OP5000 series of hardware-in-the-Loop simulators without carriers. Up to four OP5251 can be positioned in a Wanda3U / 4U and up to 8 in an OPAL-RT Expansion Box.

VUSER POWER CONFIGURATION

The digital input circuit needs a 5 V supply source to power the onboard circuitry. This source is connected to the computer's 5 VDC.

The digital outputs use an isolated DC-DC converter to power onboard circuitry.

The following resistors are used for the OP5251:

	Voltage range (Volts - continuous)	Resistor value (Ω)	Resistor Network Bourns Part Number
Digital Input	4-9	470	4608X-102-471 LF / 4308X-102-471 LF
	5-12	680 (default)	4608X-102-681LF / 4308X-102-681 LF
	6-16	1000	4608X-102-102 LF / 4308X-102-102 LF
	12-30	2200	4608H-102-222 LF / 4308H-102-222 LF
Digital Output	0-8	270	4609H-101-271 LF / 4309H-101-271 LF
	0-15	1000 (default)	4609H-101-102 LF / 4309H-101-102 LF
	0-30	4700	4609H-101-472 LF / 4309H-101-472 LF

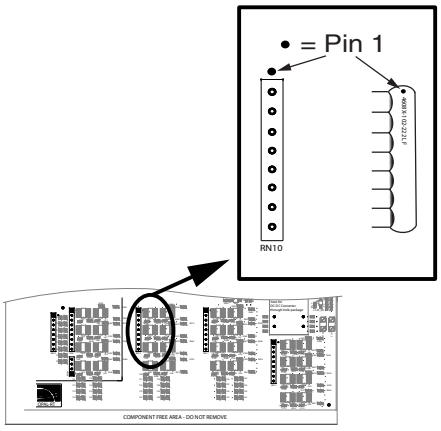
Table 1: Digital Input/Output Voltage and Resistor Values

WARNING: ensure that proper resistor network is installed to obtain desired operating voltage. Failure to do so may result in damage to OP5251 board or host setup.

VOLTAGE RANGE SELECTION

Inputs: Changing the value of resistor network RN1 to RN8 will configure the digital input voltage range in groups of 4. Using a DIP-8 isolated resistor network, make sure you match the pin 1 indicator with pin 1 on the module. If needed, you can add an additional resistor in series with the input circuit to increase the supply voltage.

Outputs: Changing the value of resistor network RN9 to RN12 will configure the output voltage range in groups of 8. Using a DIP-9 isolated resistor network, make sure you match the pin 1 indicator with pin 1 on the module. If needed, you can add an additional resistor in series with the input circuit to increase the supply voltage.



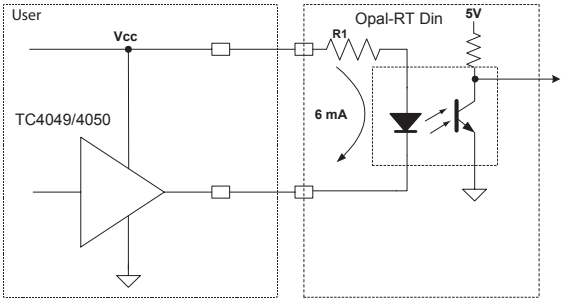


Figure 6: Digital input circuit

Each input resistor network contains 4 digital input channels. Refer to the “Resistor Network” table below for the relationship between the resistor network and input channels. To work properly, the Opal-RT digital input optical isolator needs a minimum current of 5 mA and a maximum current of 15 mA. Use the following formula to ensure safe power: (Vuser -1.5 [V]/resistor (Ω) = current (A)

Resistor network	Channel bank
RN1	Din 00-03
RN2	Din 04-07
RN3	Din 08-11
RN4	Din 12-15
RN5	Din 16-19
RN6	Din 20-23
RN7	Din 24-27
RN8	Din 28-31

Table 2: Din Resistor Network by Channel Bank

Each output resistor network contains 8 digital input channels. Refer to the Resistor Network table below for the relationship between the resistor network and inputs channels. Use the following formula to ensure safe power: Vuser (V)/resistor (Ω) = current (A).

Resistor network	Channel bank
RN9	Dout 00-07
RN10	Dout 08-15
RN11	Dout 16-23
RN12	Dout 24-31

Table 3: Dout Resistor Network by Channel Bank

All digital I/Os are accessible via a 96 pin, 3 x 32, DIN96 connector (part number 5650461-5 or 5650462-5).

Pay careful attention to the position diagram and Pin Assignment table to ensure proper and safe function.

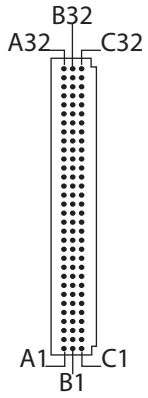


Figure 7: DIN96 Pin Assignment (female connector view)

PIN ASSIGNMENTS

Screw 126-0262	Screw 126-0075 Section A	Module pin assignment	Screw 126-0262	Screw 126-0075 SectionB	Module pin assignment
A32	1	RS422_IN_CH0-	A16	1	OUT 00 / RS422_OUT_CH0+
B32	2	RS422_IN_CH1-	B16	2	OUT 01 / RS422_OUT_CH1+
C32	3	RS422_IN_CH2-	C16	3	OUT 02 / RS422_OUT_CH2+
A31	4	RS422_IN_CH3-	A15	4	OUT 03 / RS422_OUT_CH3+
B31	5	RS422_IN_CH4-	B15	5	OUT 04 / RS422_OUT_CH4+
C31	6	RS422_IN_CH5-	C15	6	OUT 05 / RS422_OUT_CH5+
A30	7	RS422_IN_CH6-	A14	7	OUT 06 / RS422_OUT_CH6+
B30	8	RS422_IN_CH7-	B14	8	OUT 07 / RS422_OUT_CH7+
C30	9	RS422_OUT_CH0-	C14	9	OUT 08
A29	10	RS422_OUT_CH1-	A13	10	OUT 09
B29	11	RS422_OUT_CH2-	B13	11	OUT 10
C29	12	RS422_OUT_CH3-	C13	12	OUT 11
A28	13	RS422_OUT_CH4-	A12	13	OUT 12
B28	14	RS422_OUT_CH5-	B12	14	OUT 13
C28	15	Vuser-DIN	C12	15	OUT 14
A27	16	Vuser-DIN	A11	16	OUT 15
B27	17	IN 00 / RS422_IN_CH0+	B11	17	Vuser-DOUT
C27	18	IN 01 / RS422_IN_CH1+	C11	18	Vuser-DOUT
A26	19	IN 02 / RS422_IN_CH2+	A10	19	Vuser-DOUT
B26	20	IN 03 / RS422_IN_CH3+	B10	20	Vuser-DOUT
C26	21	IN 04 / RS422_IN_CH4+	C10	21	Vuser_RTN
A25	22	IN 05 / RS422_IN_CH5+	A09	22	Vuser_RTN
B25	23	IN 06 / RS422_IN_CH6+	B09	23	Vuser_RTN
C25	24	IN 07 / RS422_IN_CH7+	C09	24	Vuser_RTN
A24	25	IN 08	A08	25	Vuser_RTN
B24	26	IN 09	B08	26	Vuser_RTN
C24	27	IN 10	C08	27	Vuser_RTN
A23	28	IN 11	A07	28	Vuser_RTN
B23	29	IN 12	B07	29	Vuser_RTN
C23	30	IN 13	C07	30	Vuser_RTN
A22	31	IN 14	A06	31	RS422_OUT_CH6-
B22	32	IN 15	B06	32	RS422_OUT_CH7-
C22	33	IN 16	C06	33	OUT 16
A21	34	IN 17	A05	34	OUT 17
B21	35	IN 18	B05	35	OUT 18
C21	36	IN 19	C05	36	OUT 19
A20	37	IN 20	A04	37	OUT 20
B20	38	IN 21	B04	38	OUT 21
C20	39	IN 22	C04	39	OUT 22
A19	40	IN 23	A03	40	OUT 23
B19	41	IN 24	B03	41	OUT 24
C19	42	IN 25	C03	42	OUT 25
A18	43	IN 26	A02	43	OUT 26
B18	44	IN 27	B02	44	OUT 27
C18	45	IN 28	C02	45	OUT 28
A17	46	IN 29	A01	46	OUT 29
B17	47	IN 30	B01	47	OUT 30
C17	48	IN 31	C01	48	OUT 31

Table 4: Pin Assignments

SPECIFICATIONS

INPUT SECTION	
Number of Inputs	32
Isolation	Optical isolator
Connection mode	Common anode or Common cathode (factory configured, on request)
Input current	Minimum: 5 mA Maximum: 15 mA
Input current resistor network	Socket mounted
Detection threshold	Separate Schmitt Trigger
Voltage range	4 to 30 Vdc
Delay Low-to-High	110 ns
Delay High-to-Low	60 ns
Rise/Fall times	6 ns/6 ns
OUTPUT SECTION	
Number of Outputs:	32
Isolation:	Optical isolator
Output Drive:	Open Collector Transistor
Output Current max:	100 mA continuous
Output Protection :	150 mA Resettable Fuse
Output Voltage range:	4 to 30 Vdc
Pull-Up Load resistor network:	Socket mounted
Delay Low-to-High:	100 ns with 1 kΩ R_L
Delay High-to-Low:	50 ns
Rise/Fall times:	R_L dependant / 6 ns
Power Isolation:	On-board DC to DC isolated converter

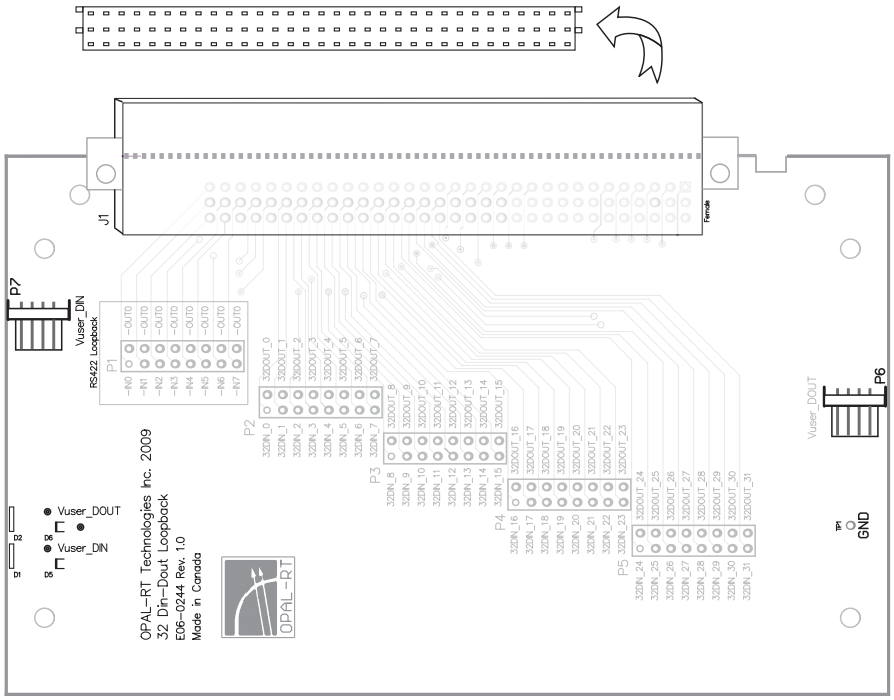
ACCESSORIES

The following accessories are available for use with the OP5251.

- 126-0284: (optional) RS422 board (shown in “RS-422 Communication Module PCB Diagram”)
- 126-0274: Female 96DIN screw terminal
- 126-0292: 64 D I/O DIN96 4 x 50 adapter
- 113-0374L (optional) 2 x 50-pins IDC50

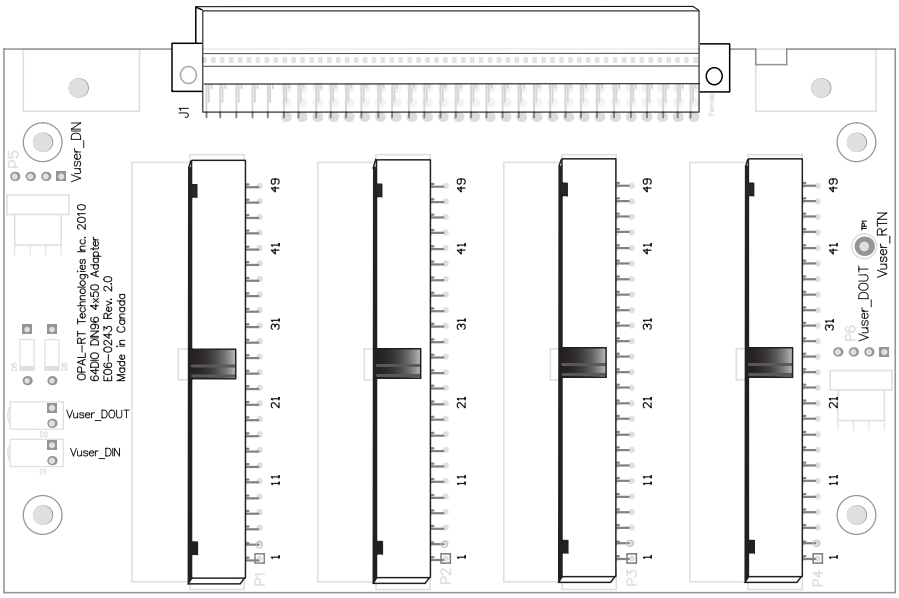
126-0274: Female 96DIN screw terminal

- Connecting directly into the OP5252, the 96DIN screw terminals allow quick and precise customized connections to specific pins (listed in Table 4).



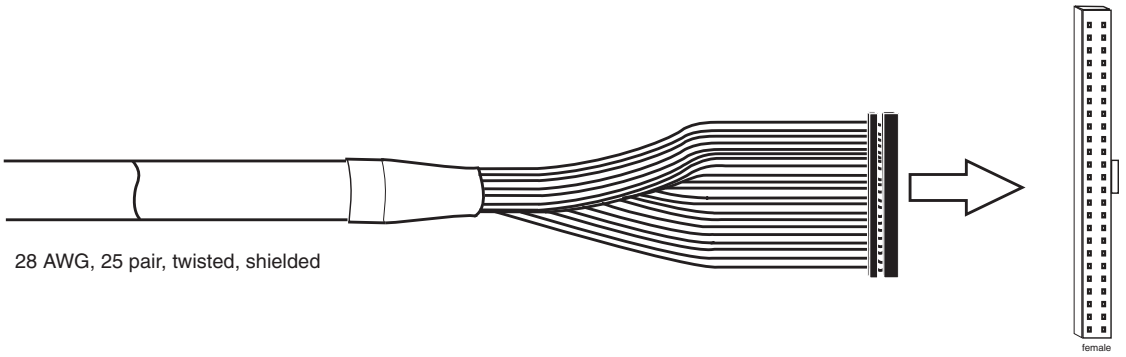
26-0292: 64 D I/O DIN96 4 x 50 adapter

This cable is used to connect twisted pair flat cable and allows for quick connections to digital Input/Output boards using four 50-pin (2x25) connectors.



113-0374L 2 x 50-pins IDC50 cable

- Round shielded cable, 25 twisted pair (for use with part number 126-0292, 64 D I/O DIN96 4 x 50 adapter)



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